Space Weather Technical Forecast

Issued on Saturday, 05 March 2022 at 13:08 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Slight Chance of G1/Minor Geomagnetic Storm this UTC weekend. Daily Chance of R1 Minor Radio Blackouts throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Low over the period, with occasional low-level C-class flares. There are currently four numbered sunspots regions on the visible disc. AR2954 has rotated off the northwest limb. AR2955 closely following on behind, and remains a simple and stable Hsx/alpha. AR2960 saw continued growth in its leading spot, although some decay of its intermediate spots. AR2957 saw proliferation and growth around its trailing spot, while AR2961 saw spreading and some fading of its intermediate spots.

A small filament was seen to disappear from the northwestern quadrant on imagery around 04/1500UTC, however this does not appear to have left the immediate solar environment. The main Coronal Mass Ejection (CME) activity in the 24 hours was a large but diffuse and slow far-sided event from the western solar hemisphere, seen into the UTC Friday evening heading well south on available imagery. No Earth-directed CMEs were in evidence.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, started the period at slightly elevated levels, near 480km/s, with a gradual decline to background levels, near 380km/s. Probably due to the waning influence of CH61/-. However, solar winds have recently increased again, back up to slightly elevated and briefly elevated levels, peaking at 515km/s at 05/1007UTC, probably due to further coronal hole influence (likely CH62/-). Phi angle was mostly negative (towards the sun), before an abrupt change in orientation to positive (away from the sun) at 05/0956UTC.The solar wind density was mostly average at the start of the period, with gradual rise to above average values, with a peak of around 12ppcc at present, which may be evidence of the approach of CH62/-. The IMF started the period mostly weak, but increased to become Moderate, with a peak of 11nT before midday on UTC day. The all important north-south component was variable, ranging from +7 to -12nT. Geomagnetic activity as a result of the above parameters was Quiet to Unsettled, with a peak of Kp3 in the 00-03UTC and provisionally an Active (Kp4) interval the 09-12UTC period.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) measured at GOES 16 was at Background levels.

The high energy electron flux (greater than 2 MeV) ranged between Normal Background and Moderate levels. The corresponding 24-hour integrated electron fluence remained well below the Active (1e8 integrated pfu) threshold, with a slight decline evident. The 05/0000 UTC observation was 3.65e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is Expected to be Low, with further occasional C-class flares and a Chance of M-class flares. No significant regions are expected to rotate onto or leave the visible

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disc through the period.

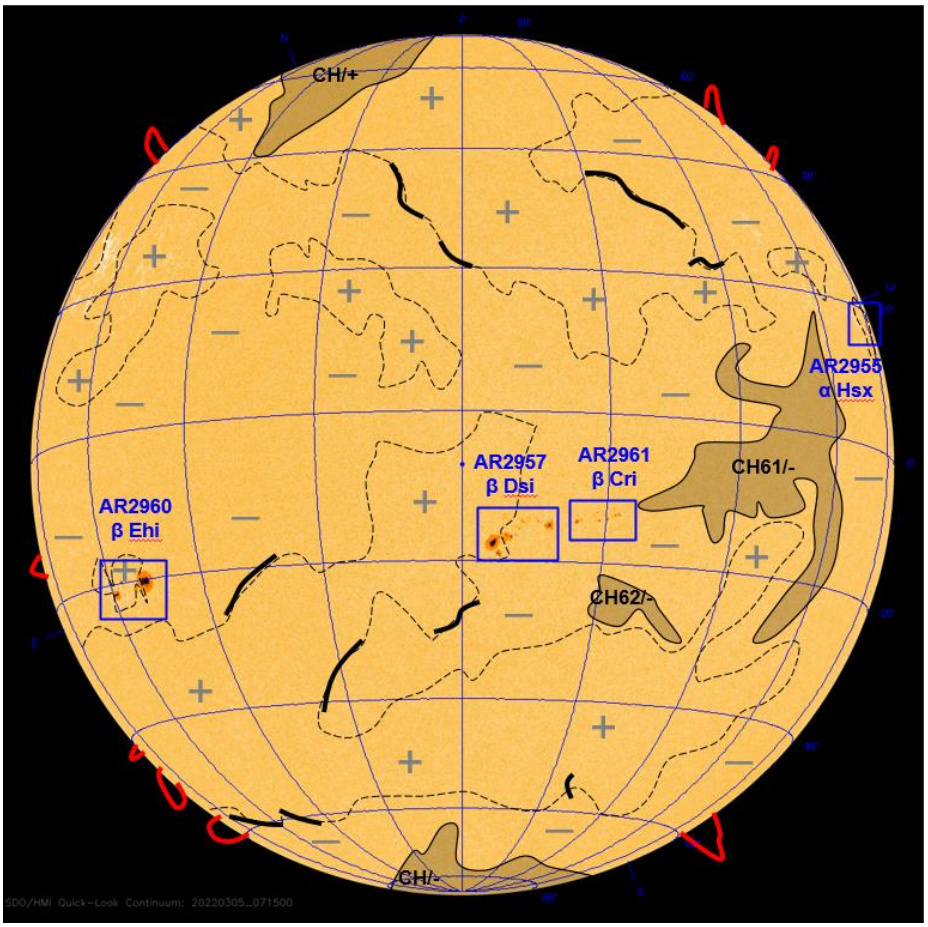
Solar Wind / Geomagnetic Activity: There are two parts to the geomagnetic forecast: the current coronal hole high speed stream(s) from CH61 and CH62, which may be indistinguishable from each other; and also a possible glance from a CME emitted on 02/1739UTC in relation to the M2.0 from AR2958.

There remains a Slight Chance (20%) of G1/Minor Storm from the high speed stream into the UTC weekend, with this risk extending later in the weekend as a result of the uncertain influence of the M2.0 associated CME. Activity should wane into the new working week, becoming most reliably Quiet by day 4 (Tuesday 08 March).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at Background levels.

The high energy electron flux is expected to be attenuated slightly over the current UTC weekend, the result of geomagnetic activity from CH61 and CH62, followed by possible further influence should the 02 March CME materialise. Geomagnetic activity should be waning into the new working week, resulting in a slight rise in fluence, with the risk peaking for the four-day period as a whole, but perhaps most likely remaining below Active as a whole.

Figure 1. Solar Analysis Valid 05/0715UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are two main aspects of the geomagnetic forecast - firstly the current high speed stream from the combination of CH61 (which has probably waned already) and CH62, although the effects from these two coronal holes are likely to be indistinguishable. Secondly, the possible marginal effects from the 02/1739UTC M2.0 CME that should mainly pass behind the Earth in the track of its orbit.

CH61 and CH62's tenuous appearance on the disc appears to be being borne out in the character of the connection to the current fast wind, with a very erratic trace in solar wind speed at L1. Current slightly elevated winds should represent the peak from this event, which should last through the upcoming UTC weekend, before beginning to wane into the new working week. Being near the vernal equinox, these negative coronal hole features should make G1/Minor geomagnetic storms possible, although the prospects of this should fall as the weekend progresses.

Modelling of the 02/1739UTC M2.0 CME revealed some MOSWOC Enlil ensemble members with 'hits' on or after 06/1200UTC, however closer inspection of their perturbations suggests that these are not favoured scenarios (e.g. excessively wide CME cone angles - compared to observed imagery). In any case, with this CME thought to be more fully aimed at STEREO A, this satellite should provide some kind of forewarning as to its likely character should it materialise at Earth.

There is the Sligh Chance (20%) of a G1/Minor Storm during day 1 (Saturday 05 March), before falling through the remainder of the period - the major contributors of CH61/62 to start the weekend, and any contribution from the CME which should follow, with the most reliably Quiet conditions then arriving by day 4 (Tuesday 08 March).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
2022-03-03 06:01UTC	Possible partial	AR2958	NE Quadrant N05E039	270km/s	After 06/1200UTC	Mainly behind Earth in orbit, low confidence in glance.

Figure 2: Latest MOSWOC Enlil model run (top) and ensemble (bottom), which shows the potential for a slight glancing blow after 06/1200UTC.

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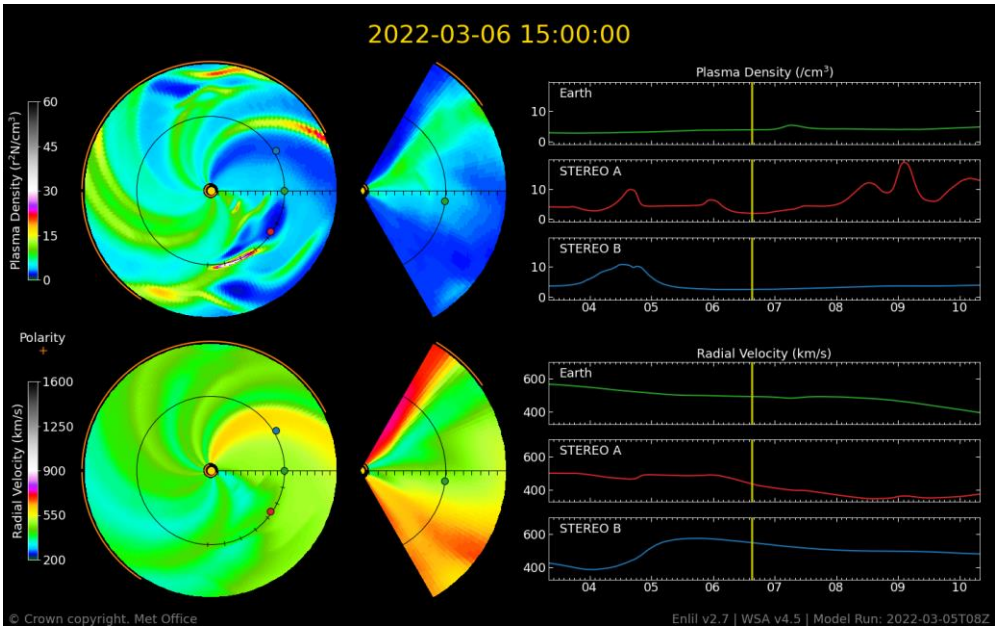

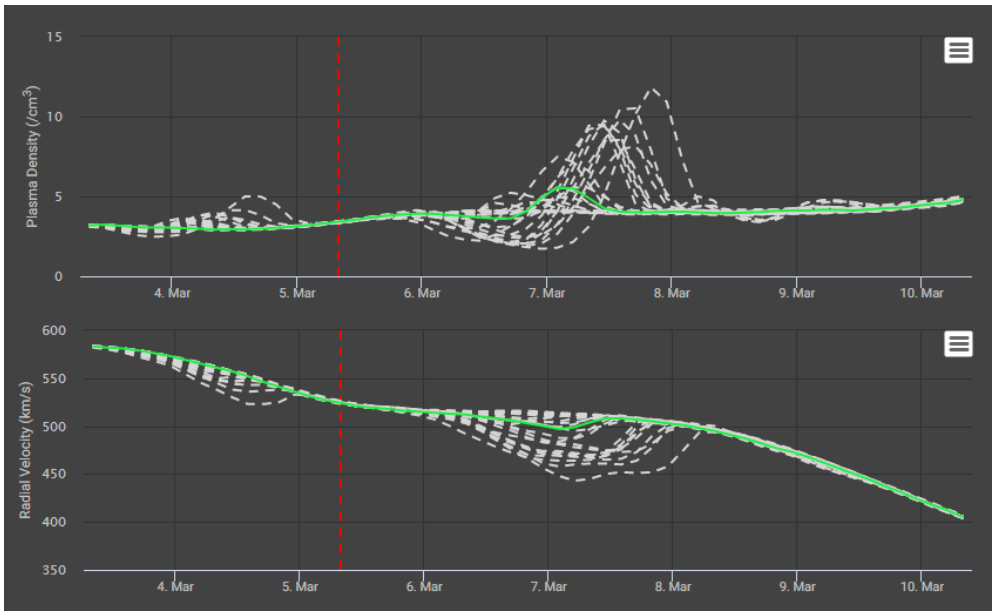

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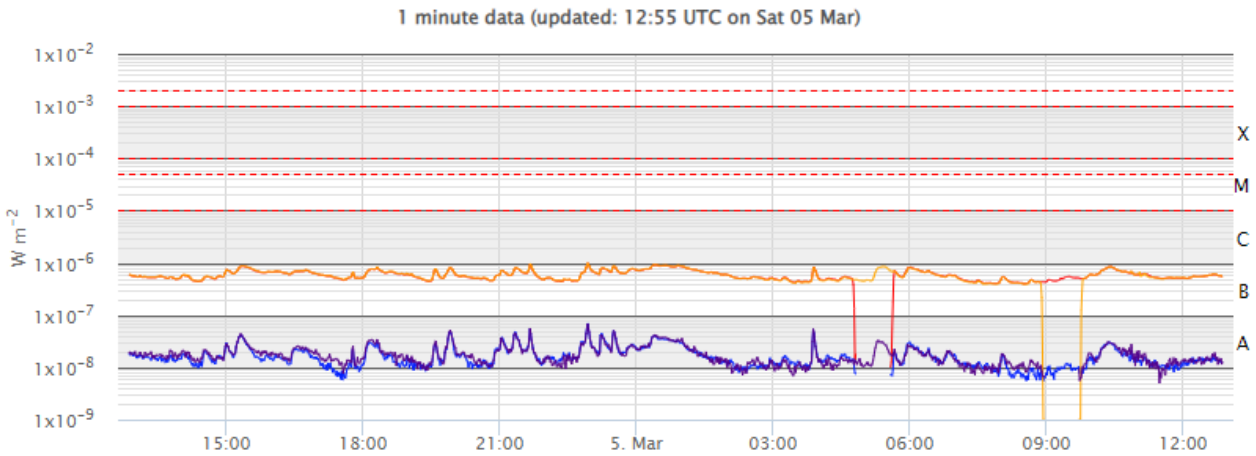
Radio Blackouts - X-Ray Flares:
Barring significant development, the contribution to X-ray flare risk from the current crop of front-sided sunspots is expected to remain largely unchanged in the four-day period, with no new returning regions, and the only spot to leave being the uni-polar AR2955 in the northwest. AR2960 in the southeast appears to be the most active of the three remaining groups, although perhaps not to the degree that a growing trend in an Ehi/Beta may suggest. Largely as a result of this region's contributions, the daily risk of C-class flares is rated at 80-90% throughout, with M-class a flat 20%. Although marginally less potent in their raw classifications, AR2961 and AR2957's presence near centre-disc will need to be monitored for their CME potential, should they flare.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	20	20	20
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES-16 X-Ray Flares.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (10MeV) measured at GOES 16 is currently at Background levels. The slightly increasing trend in the probabilities is the result of the centre-disc sunspots' nominal potential to produce S1+ events should they flare as they continue westward into slightly more geo-effective positions.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	2	2
Very Active	**≥ S3 ***	No	1	1	1	1

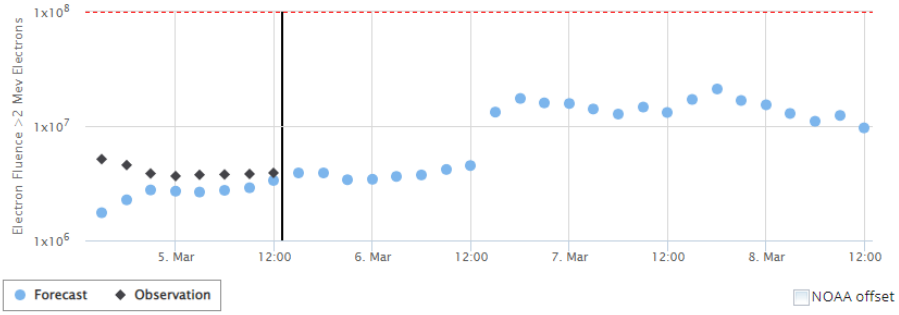
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) has been at Normal Background to Moderate levels during the past 24 hours.
The high energy electron flux is expected to be attenuated slightly over the current UTC weekend, the result of geomagnetic activity from CH61 and CH62, followed by possible further influence should the 02 March CME materialise. These features' geomagnetic activity should be waning into the new working week, resulting in a slight rise in fluence, with the risk peaking for the four-day period as a whole, but perhaps most likely remaining below Active even here.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	10	25	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: REFM electron fluence observations and forecast, which shows an increasing trend towards the end of the period.



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